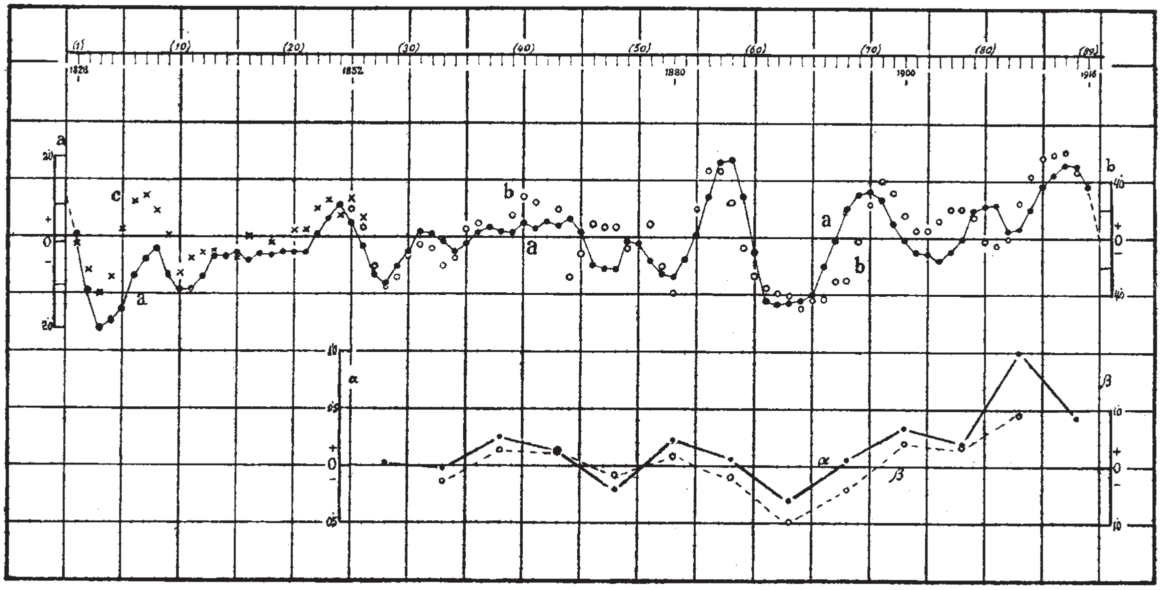
planation. There are sufficient names, but crowding has been avoided. The British front in June is shown by a red line. It is a clearly printed and useful map with a great amount of detail, and allows the progress of operations, both on the Belgian front and along the coast, to be closely followed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Forecast of Coming Winters.

A STATISTICAL examination of ancient records of winter temperatures in Western and Western-Middle Europe led me to the conclusion, in 1904 and 1905, that periodicities of 44½ and 89 years have the greatest influence on the occurrence of mild and severe winters in this part of the world. These periodicities, undoubtedly related to similar fluctuations in the sun's activity, are especially manifest in lower winter temperatures at the beginning, and in higher winter temperatures in the latter part, of the periods. Thus, in the 89-year period 1828–1916, the winter temperature is generally lower in the first and third 22-year interval, and comparatively high in the second and fourth; the interval 1828–49 being the coldest, the interval 1895–1916 the warmest part of the whole period. Not only the monthly means, but also the frequency of mild and severe winters, show this periodicity.



89-year periodicity of winter-temperature in W. Europe. "a" and α (full-drawn lines), historical; "b," "c" β, instrumental data.

So early as 1905 I pointed out[1] that a series of warm winters might be expected in the following years, according to these statistics, and that the year 1917 marked the beginning of a new period of *comparatively* cold winters. Though it seems a matter of mere chance that exactly the winter 1916–17 turned out to be the first cold winter after so many mild winters as we experienced since the beginning of this century, the first really cold winter since 1895 in W. Europe; nevertheless, a change in the weather-type about this time is in perfect agreement with the forecast.

Since the publication of my first paper on this subject I have been collecting and critically examining all materials on winter temperature that are available on the Continent and in England, in order to trace the *vera causa* that must lie hidden behind such a period or complex of periods. I did not, however, succeed; even the Fourier analysis, applied to these data with the kind assistance of Dr. Van der Stok at the R. Institution of Meteorology, in De Bilt, failed to give a clue.

There remained, however, a means of testing the reality of the suspected 45-year or 89-year periodicity. If this periodicity were real, the curve representing the thermometrical observations, made during the latter half of the nineteenth century, at some representative stations in W. Europe, *e.g.* Paris and Utrecht (De Bilt), should fit in with the 89-year curve derived from the "historical data." The result of such a comparison can be seen in the diagram, where the full-drawn line "a" gives the "historical" 89-year curve, "b" (dotted) the "thermometrical" curve since 1852, the crosses marked "c" having been added in order to trace back the instrumental records to the year 1828, although this part of the curve had to be taken from less trustworthy data. All this applies only to the western part of Europe. The curves α and β represent the same data since 1852, simplified and smoothed. Making allowance for a certain shifting of the phase in the latter part of the curve, the dips and crests show, I think, so much analogy as to preclude a purely accidental conformity of the two curves, compiled from absolutely different data.

Want of space compels me to refer the reader to my paper, just issued by the Amsterdam Academy of Sciences.[2] I must now confine myself to give a table showing the frequency of cold and severe winters in periods of 22 (22⅛) years since A.D. 760; period

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[1] "Oscillations of the Solar Activity and the Climate" (Proc. Roy. Acad. Sci., Amsterdam, vols. vii.–viii., 1904–5).

[2] "Periodicity of Winter Temperatures in Western Europe since the Year 760" (Proc. Roy. Acad. Sci., Amsterdam, vol. xxv., 1917).

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No. XIII. thus running from 1828 to 1916. The deficiency of severe winters in the last column is striking.

Frequency of (a) *Cold,* (b) *Severe Winters,* 760–1916.

89-year Period	Period-year 1–22		Period-year 23–45		Period-year 45–67		Period-year 68–89	
No.	Cold	Severe	Cold	Severe	Cold	Severe	Cold	Severe
I.	1	(1)	0	(0)	1	(1)	0	(0)
II.	1	(1)	1	(1)	2	(1)	2	(0)
III.	2	(1)	1	(0)	3	(1)	1	(0)
IV.	3	(1)	2	(0)	2	(2)	1	(0)
V.	3	(1)	2	(1)	2	(1)	0	(0)
VI.	5	(2)	1	(1)	3	(1)	1	(0)
VII.	2	(1)	3	(1)	2	(0)	1	(1)
VIII.	3	(0)	2	(1)	3	(2)	2	(1)
IX.	1	(0)	2	(1)	2	(0)	1	(0)
X.	2	(1)	2	(0)	2	(2)	0	(0)
XI.	4	(1)	1	(1)	3	(1)	0	(0)
XII.	1	(1)	3	(0)	4	(3)	1	(0)
XIII.	2	(1)	2	(0)	2	(2)	1	(0)
VIII.–XIII.	2·2	(0·7)	2·0	(0·5)	2·7	(1·7)	0·8	(0·2)
I.–XIII.	2·3	(0·9)	1·7	(0·5)	2·4	(1·3)	0·8	(0·2)

The conclusions of the whole investigation may be summarised as follows (all this relates, of course, to winter temperatures in W. Europe):—

(1) Within each interval of $44\frac{1}{2}$ years (759·5–803·0 . . . 1872·0–1916·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 20° per 44 winters; after the year 1383 on an average 26°.

Exceptions, or apparent exceptions, from this rule, two out of twenty-six cases since 760, none since 1200.]

(2) Within each interval of 89 years, to begin with the year 759·5 (1827·5), the first half is colder than the second.

[The difference in the amount of temperature-deviation has been found on an average 22° per 89 winters.

Exceptions from the rule, two out of thirteen cases since 760, besides two doubtful ones; since 1116 one exception.]

(3) The chance that the last quarter of an 89-year period (826·25–848·5 . . . 1894·25–1916·5) contains a smaller number of hard winters than the preceding and following 22-year intervals is 0·88. Within the last quarter of an 89-year period the chance that any winter will be severe (or very severe) is less than 0·4 (or 0·007), *i.e.* less than $\frac{1}{2}$ ($\frac{1}{5}$) of the general chance. In the neighbouring 22-year intervals (*e.g.* 1872–93 and 1916–37) this chance is about three (five) times as great.

(4) Increased and accelerated activity of the solar surface corresponds in general with the winter-cold in Western Europe setting in more forcibly and quickly than usual; inversely, a weakened and retarded activity of the sun corresponds with winters setting in more mildly and in a later part of the period.

The forecast for the period 1917–38, derived from these statistics, indicates at least two very cold and one severe winter; the average winter temperature for these twenty-two years being generally below the 89-year mean. C. Easton.

Amsterdam, June, 1917.

Auroras and Magnetic Storms.

With reference to your note in Nature of August 16 referring to a magnetic storm on the night of August 9–10, it may be of interest to learn that an aurora was seen here that night. It was first seen a few minutes before 10 p.m. (G.M.T.), when it appeared as a glow in the northern sky. Two streamers were just discernible at first, but they gradually increased in numbers and became clearer, at the same time growing longer and brighter and moving towards the west. The longest reached to the centre of the Great Bear. Small, sharp, and delicate streamers, although not prominent, were distinctly seen in the larger streamers. There was no colouring seen at all, but merely a white glow. By 11.15 all traces of it had vanished. L. Cave.

Testing Squadron, Royal Flying Corps,
Martlesham Heath, Suffolk, August 21.

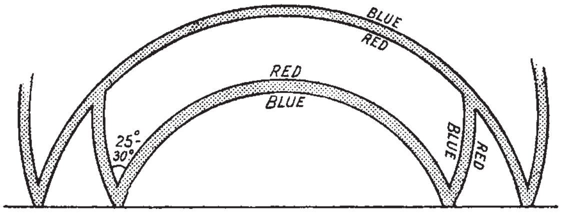
An Unusual Rainbow.

An unusual rainbow display was visible at sea between 6.30 and 7 p.m. on the evening of August 16. The primary and secondary bows were complete and of exceptional brilliancy. Between these two lay two arcs of a third bow, cutting the primary bow near the horizon and ending in the secondary bow about 20° above the horizon in the manner shown in the accompanying diagram.

The blue of this bow was towards the primary bow, and the red towards the secondary bow. This third bow cut the primary bow at an angle of 25°–30°.

Outside the secondary bow were visible two arcs of a fourth bow (less distinct than the others) which cut the secondary bow in much the same way as the third cut the primary.

Unfortunately, I am unable to give you at present the ship's position at the time when the phenomenon was seen. The sun's altitude was about 7° when the bows were most clearly seen. The afternoon was warm and sultry and there was practically no wind. A thunderstorm took place at some distance from the ship during the afternoon.



I shall be glad if any of the readers of Nature can give me an explanation of the phenomenon, which has caused considerable discussion among the officers of the ship. Allan J. Low.

August 16.

An Invasion of Ants.

Yesterday afternoon (Bank holiday) the weather suddenly became brilliantly sunny and very hot, after some days of gloom with rain and thick east wind atmosphere; and about five o'clock I became aware that apparently every ants' nest in the garden had chosen that precise moment for the emergence of its winged inhabitants. There they were in myriads, swarming out of holes in the drive, gravel paths, flagstones, the rock-garden, where they had been devastating Sempervivum clumps, and all over the lawns. They were nearly all the small red ant, only a few nests of the small black one.

The tiny winged males much outnumbered the large-bodied winged females, and both were attended by fussily anxious "workers"; by seven o'clock all were gone. Can ants delay their appearance above ground until the onset of suitable hot, dry weather?

Eleonora Armitage.

Dadnor, Herefordshire, August 7.

The appearance in swarms of male and female ants for the nuptial flight is described by many observers.

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